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SILVICAL CHARACTERISTICS OF SCARLET OAK
(Quercus coccinea, Muenchh.)

by

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Scarlet oak (Quercus coccinea Muenchh.) sometimes is called Spanish oak and occasionally black oak. Both the preferred common name and the scientific name are derived from the brilliant scarlet color of its autumn leaves.

RANGE

The natural range of scarlet oak includes the whole or a part of all states east of the Mississippi River except Wisconsin, Florida, and perhaps Mississippi (fig. 1). Its range west of the Mississippi River is limited to southeast Missouri (16). It is frequently and successfully planted outside its natural range as an ornamental tree.

USES

Betts (1) indicates scarlet oak is a very important timber species in the Alleghanies, and it ranks seventh nationally among the oaks. It is discriminated against by the sawmiller because of frequent and severe borer damage and decay, but when cut from a good site its yield of high quality lumber approaches that of northern red oak (3).

HABITAT CONDITIONS

CLIMATIC

The entire range of scarlet oak is classed as humid (26). Average annual precipitation over its range varies from 30 inches in the West to 55 inches in the Southeast and at the higher elevations. Maximum elevation for scarlet oak as reported by Sargent (21) is 5,000 feet and this occurs in the Southern Appalachians. However, it is usually found at elevations under 3,000 feet (24).

EDAPHIC AND PHYSIOGRAPHIC

Scarlet oak occurs on a wide variety of soils within its range. The great soil groups with which it is most frequently associated are the gray-brown podzolic soils in the North and the red and yellow podzolic soils of the South (27). Scarlet oak is most often found on average to less than average sites. It is a typical upland oak species of the ridges and upper and middle slopes. However, it makes its best growth on moist, well-drained cove soils.

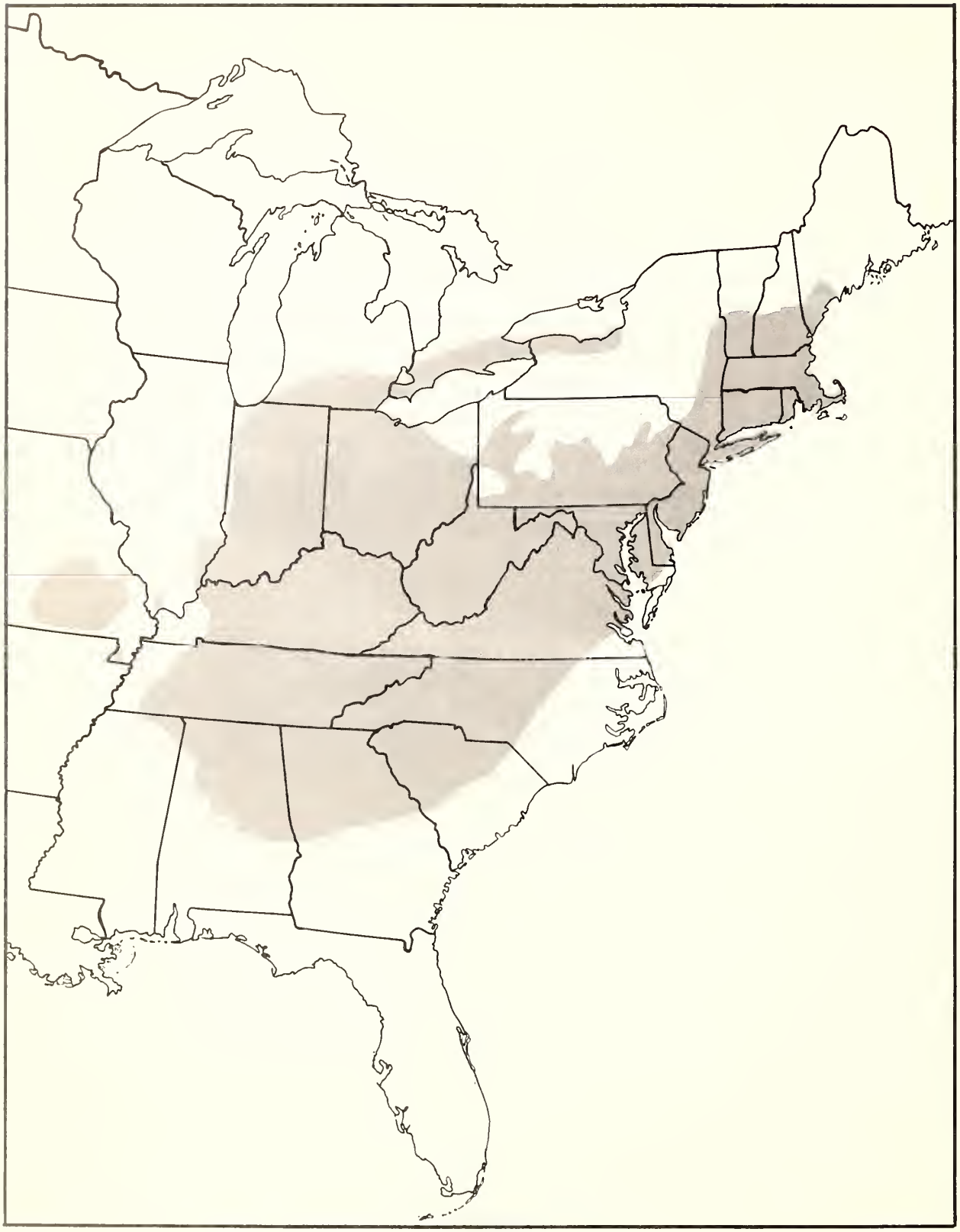

Figure 1.--Botanical range of scarlet oak.

In a study of soils and site in the Southern Appalachians, Doolittle (6) found that the site index of scarlet oak ranges from 37 to 91 feet (at 50 years). Trimble and Weitzman (25) reported that this species has the highest site index ratio (1.03) of the five common oak species found in the northern Appalachians. Although this species apparently regenerates and competes best on the poorer and lighter soils, Doolittle's study shows that site index of this species increases with increasing depth of A horizon, decreasing amounts of sand in the A horizon, and with lower positions on the slope. Position on slope was also considered an important factor by Trimble and Weitzman along with aspect, grade of slope, and depth of soil to bedrock.

Although its place in succession is not clear, scarlet oak probably approaches climax on dry soils (24). Due to its hardiness, scarlet oak is planted on an even wider variety of soils than those on which it grows naturally.

BIOTIC

Scarlet oak is a component of 15 of the 106 cover types listed for North America (24). It is the major species in its own type. With it are found black oak (Quercus velutina) and southern red oak (Quercus falcata) as coordinate species. Other associated species include chestnut oak (Quercus prinus), white oak (Quercus alba), post oak (Quercus stellata), the hickories (Carya spp.), pitch pine (Pinus rigida), shortleaf pine (Pinus echinata), Virginia pine (Pinus virginiana), black gum (Nyssa sylvatica), sweetgum (Liquidambar styraciflua), and black locust (Robinia pseudoacacia).

Small patches of almost pure black oak are occasionally found within the type. The type grades into post oak-blackjack oak on very dry sites (24).

The more common minor trees and shrubs found with scarlet oak include: dogwood (Cornus florida), mountain-laurel (Kalmia latifolia), sourwood (Oxydendrum arboreum), and blueberries (Vaccinium spp.)

Scarlet oak acorns are a choice food for eastern gray squirrels (Sciurus carolinensis), chipmunks (Tamias striatus), mice (Peromyscus spp.), and birds, especially the blue jay (Cyanocitta cristata) (14).

LIFE HISTORY

SEEDING HABITS

Like most oaks, scarlet oak flowers sometime in April or May, depending on latitude, elevation, and variations in weather. Two full growing seasons are required between fertilization and maturity for acorns.

Good seed crops were observed every 3 or 4 years by Downs and McQuilkin (7) in the Southern Appalachians, whereas the Woody-Plant Seed Manual (29) indicates an irregular period of good seed crops. Burns et al. (2) concluded from their Missouri study that oak seed production varied

greatly from year to year for all five oaks studied, but that scarlet oak was the most variable among black, white, post, blackjack, and scarlet oaks. They also found that scarlet oak was the most prolific seeder in the years that it did have a good crop. They failed to find, during their 6-year study, any clearly defined cycles of seed production for any of these oaks, but concluded that a good crop appears at least once every 5 years for each species. Downs and McQuilkin found that seed production increased rapidly with tree size up to 20 inches d.b.h. and then levelled off for this species in the Southern Appalachians. Burns et al. could not tie seed production to measurable tree characteristics. Scarlet oak is the last of five species studied to lose its acorns in the fall, according to Downs and McQuilkin.

Downs and McQuilkin (7) also found that from 20 to 60 percent of the annual crop consisted of sound acorns. The higher proportion accompanies the years of greatest seed production. Birds and squirrels were responsible for 44 percent of the total damage to acorns of all species while the acorns were still on the tree, and insects were responsible for the remaining 56 percent of the total. A similar degree of insect damage was reported by Burns et al. (2). After seedfall, insects again did the most damage; in the case of scarlet oak the sources of damage to acorns are as follows: 36 percent from birds and 64 percent from insects (7). Of those sound acorns reaching the ground, Downs and McQuilkin found a higher proportion were consumed by deer than by squirrels. Korstian (14), in his Southern Appalachian study, found three groups of insects responsible for acorn damage: nut weevils (Curculio spp.), moth larvae (Valentina glanduella), and gall cinipids (Cynipidae). He also reported that insect injury to acorns was higher in the black than in the white oaks. Of these insects, Downs and McQuilkin considered nut weevils the most harmful.

In seeding or nursery practice, fall seeding is recommended. If held till spring, the acorns should be stratified (29).

Scarlet oak seedlings are very susceptible to fire damage (14). This weakness coupled with a dry environment helps explain the high mortality or severe damage to seedlings even from light ground fires.

VEGETATIVE REPRODUCTION

Roth and Sleeth (20) found that scarlet oak stumps in the Appalachians produced sprouts to greater ages and to larger sizes than the other oaks. In southern New Jersey Little (17) also found that scarlet oak sprouts were the most vigorous of all oaks studied, and in common with associated oaks, regeneration by sprouting was very successful when stumps were small, but decreasingly so as size and age increased to sawtimber size.

Roth and Sleeth reported that 28 percent of the scarlet oak sprouts in their study had butt rot, and that sprouts from large stumps were more subject to butt rot than sprouts from small stumps. As the sprouts grow older, the rot spreads and may weaken the trees to a point where they break off during periods of high winds.

SEEDLING DEVELOPMENT

In 1927 Korstian (14) proved that a light covering of forest litter was helpful to the germination of acorns. He also found that no litter and too deep a covering were not as favorable as a light covering. Partial cutting provides more favorable conditions for germination than does seed-tree cutting, according to Downs (7). He recommended a 2-cut shelterwood method, with the first cut to provide for germination and the second cut to be made as soon as the seedlings are established to allow for better growth.

SAPLING STAGE TO MATURITY

Scarlet oak is a medium-size tree, normally maturing at 60 to 80 feet in height and 2 to 3 feet in diameter. Maximum size is 100 feet tall and 4 feet in diameter (10).

Scarlet oak is a tree of rapid growth and early maturity. Hursh and Barrett (12) found that it ranked next to yellow-poplar in rate of diameter growth in their north Georgia study. Campbell's Southern Appalachian study (4) confirmed this rapid growth rate, but both scarlet oak and yellow-poplar were outgrown by northern red oak. However, on poor sites scarlet oak probably grows more rapidly than any other species. McIntyre's (19) study of growth rates among the oaks in Pennsylvania showed for the smaller sizes of sawtimber that black oak grew 0.8 inch radially in 10 years and exceeded northern red, scarlet, white, and chestnut oak, in that order.

For survey purposes scarlet oak was grouped with other red oaks (except northern red) by McCormack (18) and the entire group contained about the same volume as chestnut oak, which has the largest volume of any one species in the mountain area of North Carolina. Farther north (in the Alleghanies) it is expected that scarlet might be the major single species (1). Stands of pure scarlet oak on the better dry slopes and ridges produce yields approximately equal to chestnut oak, or an estimated 7,000 board-feet at 80 years (8).

Schnur's study (23) shows that mean annual cubic growth for the oaks in general culminates at about 50 years for all sites, and ranges from a high of 70 cubic feet for site 80 to a low of 25 cubic feet for site 40. The mean annual board-foot growth culminates at 75 years of age on the better sites and at 100 years for the poorer ones. Annual board-foot growth per acre ranges from a high of 335 for site 80 to a low of 90 for site 40. Cubic and board-foot volume tables for various tree heights and diameters are also shown for each of the oak species in this same publication. Total yields per acre in cubic feet and board-feet were adapted from Schnur's bulletin and are shown in table 1.

Economic maturity for scarlet oak drops rapidly from 23 inches d.b.h. for a tree of vigor class 1 down to 18 inches for a tree of vigor class 3 (4).

Because of its thin bark, scarlet oak is very susceptible to fire damage; if not killed outright, the tree is usually injured so that sap or heart rots enter.

Table 1.--Mixed oak yields per acre, by site index class

Total age (Years)	Site index of 40 feet		Site index of 60 feet		Site index of 80 feet	
	Cubic feet	Board-feet	Cubic feet	Board-feet	Cubic feet	Board-feet
20	20	0	170	0	620	350
40	680	600	1,580	3,200	2,610	8,600
60	1,420	2,700	2,800	9,700	4,160	18,600
80	2,050	5,900	3,730	15,650	5,340	27,250
100	2,590	9,200	4,480	20,900	6,380	34,400

In a laboratory study by Scheffer et al. (22) it was found that wood from the red oak species was more susceptible to decay than wood from the white oaks, but that scarlet oak wood was no more susceptible than the wood of other red oaks. In living trees, however, heart rot becomes critical in scarlet oak at an early age because of persistent branch stubs, which allow heart rots to enter.

Scarlet oak is also susceptible to oak wilt (Endoconidiophora fagacearum) (28). Trees attacked by this fungus may die within a month after the first symptoms become evident. Hepting (11) lists this oak as being subject to cankers of Nectria spp. and Strumella coryneoidea. These diseases are especially severe from Virginia northward.

Because insect pests are so numerous, only the more common and serious ones will be discussed. The spring cankerworm (Paleacrita vernata), the fall cankerworm (Alsophila pometaria), and the forest tent caterpillar (Malacosoma disstria) (5, 13) are defoliators which do no great damage in one year's time, but when the outbreaks last for several years, as they frequently do, the affected trees are greatly weakened and suffer loss in growth. Occasionally these repeated attacks result in death of the affected tree. Walking stick (Diapheromera femorata) is another defoliator which feeds largely on the oaks, particularly in the Lake States. All of the defoliator larvae can be destroyed in the feeding stage by the aerial application of a DDT spray (15). The 2-lined chestnut borer (Agrilus bilineatus) is a secondary pest of the oaks following drought, fire, or other unfavorable changes in the tree's habitat.

On a basis of volume of logs damaged by insect attack in eastern Kentucky, Hay and Wootten (9) found that scarlet oak ranked next to chestnut oak in severity of damage. Larvae of the carpenter worms (Prionoxystus spp.) tunnel in all directions in both heartwood and sapwood of oak trees; consequently they do much damage to the lumber. Members of two ambrosia beetle genera, Platypus and Xyleborus, are very harmful to freshly damaged or cut trees.

SPECIAL FEATURES

The brilliant autumn coloring of the leaves of scarlet oak makes it a choice ornamental over most of eastern United States. The bark is fairly high in tannin content but the tree has not been commercially used for this product.

RACES AND HYBRIDS

Sargent (21) and Little (16) list two crosses or hybrids of scarlet oak. One is Quercus x robbinsii Trel. (Quercus coccinea x ilicifolia), and the other is Quercus x benderi Baenitz (Quercus coccinea x rubra). Little also notes that Quercus x robbinsii may be hard to distinguish from Quercus ellipsoidalis.

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